

Patterns of children's growth in East-Central-Europe in the eighteenth century

Komlos, John

Veröffentlichungsversion / Published Version
Sammelwerksbeitrag / collection article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
GESIS - Leibniz-Institut für Sozialwissenschaften

Empfohlene Zitierung / Suggested Citation:

Komlos, J. (1987). Patterns of children's growth in East-Central-Europe in the eighteenth century. In W. H. Schröder, & K. H. Jarausch (Eds.), *Quantitative history of society and economy: some international studies* (pp. 120-141). St. Katharinen: Scripta Mercaturae Verl. <https://nbn-resolving.org/urn:nbn:de:0168-ssoar-341642>

Nutzungsbedingungen:

Dieser Text wird unter einer Deposit-Lizenz (Keine Weiterverbreitung - keine Bearbeitung) zur Verfügung gestellt. Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen.

Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

Terms of use:

This document is made available under Deposit Licence (No Redistribution - no modifications). We grant a non-exclusive, non-transferable, individual and limited right to using this document. This document is solely intended for your personal, non-commercial use. All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public.

By using this particular document, you accept the above-stated conditions of use.

Patterns of Children's Growth in East-Central-Europe in the Eighteenth Century *)

John Komlos

Recent research has established a clear link between human stature and the nutritional status of populations ¹⁾. My intention here is to exploit this known link and on the basis of the cycling in human stature in the eighteenth century make inferences on the economic conditions, primarily agricultural, of the time.

My analysis of the stature of boys in the Habsburg monarchy in the eighteenth and early nineteenth centuries is based on three sources which include some of the earliest data on heights hitherto extracted from any archive ²⁾. The first source is the military academy founded by Maria Theresia in the 1750s to train officers. Five hundred sixty observations have survived on aristocratic adolescents born in the 1730s and 1740s ³⁾. The second data set of 366 observations stems from an orphanage, the Josephinische Waisenhaus, founded by Maria Theresia's son Joseph II, and contains information on children of various ages born in the 1760s and 1770s ⁴⁾. The third, and major, source of data for this study is schools run by the military for sons of ordinary soldiers ⁵⁾. Exactly

*) The support of an NICHD National Research Service Award 2T32 HD07168 from the Center for Population Research is gratefully acknowledged. Computation was done at the computing center of the Wirtschaftsuniversität, Vienna. I appreciate the hospitality of the rector of the university, Professor Herbert Matis, and the help of Walter Story, director of the center, in bringing this study to fruition. I gratefully acknowledge the assistance of Klaus Erhard, Erich Foltyn, Paul Mageli, Asha Narang, and Nona Schlegel in extracting the data from the archives and rendering them machine readable. Markus Hein helped with the computation diligently. I benefited greatly from comments by Professors J. M. Tanner and Richard Steckel. This study is a slightly revised version of a paper forthcoming in the *Annals of Human Biology*, republished here with permission of the editors of that journal. I would also like to express my gratitude to Professor Robert Fogel for awakening my interest in the history of human stature.

1) Robert Fogel, S. Engerman, Roderick Floud, R. Margo, K. Sokoloff, Richard Steckel, J. Trussell, G. Villafior, and Kenneth Wachter, "Secular Changes in American and British Stature and Nutrition," *Journal of Interdisciplinary History* 14 (1983), p. 445; Robert Fogel, S. Engerman, and J. Trussell, "Exploring the Uses of Data on Height: The Analysis of Long-Term Trends in Nutrition, Labor Welfare, and Labor Productivity," *Social Science History* 6 (1982), p. 401.

2) James M. Tanner, *A History of the Study of Human Growth* (Cambridge, 1981). James M. Tanner, *Fetus into Man: Physical Growth from Conception to Maturity* (Cambridge, Mass., 1978).

3) Kriegsarchiv, Vienna, Theresianische Militärakademie, Faszikel, 434.

4) Kriegsarchiv, Vienna, Josephinische Waisenhaus, Faszikel, 3922.

5) Kriegsarchiv, Vienna, Erziehungshäuser Musterlisten, Faszikel, 3925, 3926, 3927. All

25,071 valid data have been put on tape from this source. Besides height (to the nearest 0.6 centimeter), age (year and month) and birthplace of the boys were also recorded⁶).

Regression analysis indicates that height of aristocratic adolescents generally did not depend on their place of birth (Equation 1, Table 1). Those born in Bohemia, however, were significantly taller than the average. A number of features of the height of the aristocrats stand out (see Table 1).

1. Those born between 1735 and 1744 were shorter than those born during the next decade (Table 2). Stature of the youth increased significantly in the late 1740s and early 1750s by three to six cm, depending on their ages.

2. In spite of the increases in average height, aristocratic youth aged 14 and above were not taller than boys in the orphanage born two decades later (Table 2).

That average height of the aristocratic youth born between 1745 and 1755 increased implies that their nutritional status was improving. All increases in stature were attained prior to entering the military academy, and hence could not be attributed to changes in the diet boys received at the institution. Adult Hungarian peasant recruits into the Habsburg army at the same time experienced similar increases in stature⁷). This pattern is plausible since we know that agricultural conditions were good and improving in Europe and North America in the 1730s and 1740s⁸). Although one might have thought that the income of

data from Faszikel 3926 and 3927 have been recorded. From Faszikel 3925 only those children's heights were recorded who were born in Galicia, Moravia, Hungary, Bohemia, and Lower Austria. Consequently the data set could be expanded from this faszikel by a few thousand records of children of other nationalities. Although serial measurements are available on many of the boys, these were not obtained, since looking up the names of the boys in subsequent years would have been quite a task. Although it would have been a statistically more accurate method than the one chosen, especially for calculating growth velocities, it was not feasible within the time available to me. Children entered the military school system at all ages and remained in it usually for a number of years. Hence, many multiple observations are in the sample.

6) Eighteen nationalities were distinguished. The name and religion, also available, were not recorded. Height was measured in Austrian units: Schuh, Zoll, and Strich; 4 Strich = 1 Zoll and 12 Zoll = 1 Schuh; 1 Schuh = 31,6 cm. Age is as of the previous birthday.

7) John Komlos, "Stature and Nutrition in the Habsburg Monarchy: The Standard of Living and Economic Development in the Eighteenth Century." *American Historical Review*, 90 (Dec., 1985), pp. 1149 - 1161.

8) R. M. Hartwell, "The Causes of the Industrial Revolution: An Essay in Methodology", in: R. M. Hartwell (ed.), *The Causes of the Industrial Revolution in England* (New York, 1967), p. 87. Herbert Mats, "Die Rolle der Landwirtschaft im Merkantil-system - Produktionsstruktur und gesellschaftliche Verhältnisse im Agrarbereich," in: Herbert Mats (ed.), *Von der Glückseligkeit des Staates; Staat, Wirtschaft und Gesellschaft in Österreich im Zeitalter des aufgeklärten Absolutismus* (Berlin, 1981), p. 273. In the British colonies of North America the quantity of food, particularly pork, found

	(1)	(2)
Intercept	142.6 *	143.1 *
Birth-Year		
1740/44	- 1.4	- 1.3
1745/49	3.2 *	3.3 *
1750s	5.6 *	5.9 *
Birthplace		
Moravia	1.1	
Bohemia	2.7 *	
Galicja	- 2.2	
Hungary	0.3	
Lower Austria	- 0.4	
Italy	- 0.3	
Age		
11	-10.4 *	-10.4 *
12	- 7.2 *	- 7.4 *
13	- 3.0 *	- 3.1 *
15	5.6 *	5.7 *
16	9.5 *	9.9 *
N =	556	556
R ² =	.40	.39
F =	23.8 *	36.7 *

Table 1. Equations 1 - 2. Dependent variable: Height in centimeters of Habsburg Aristocrats, 1735 - 1755.

* Significant at the 1% level

Equation (1): Intercept indicates the height of a 14-year-old born outside of the six provinces before 1740.

Equation (2): Intercept indicates the height of a 14-year-old born before 1740. Birthplace is not taken into consideration.

Note: All independent variables are dummy variables.

	12 yrs.			13 yrs.			14 yrs.			15 yrs.		
	N	H	s. d.	N	H	s. d.	N	H	s. d.	N	H	s. d.
1735/44 a	55	134.2	7.2	114	138.4	7.2	88	142.7	7.8	49	148.9	8.1
1745/55 a	18	140.4	5.2	51	144.2	7.7	68	145.7	6.4	43	152.4	8.6
1760/64 b		n.a.			n.a.			n.a.		20	154.0	6.5
1765/69 b	41	137.0	6.7	40	141.4	6.7	32	146.2	6.3		n.a.	
1770/74 b		n.a.			n.a.			n.a.			n.a.	
1775/79 c		n.a.			n.a.			n.a.		27	149.9	11.7
1780/84 c		n.a.			n.a.		22	144.8	7.3	30	148.6	9.4
1785/89 c	188	132.5	6.5	238	137.3	6.3	242	141.1	6.8	383	147.0	8.4
1790/94 c	353	132.2	5.9	366	137.0	6.8	478	141.5	7.2	442	146.7	8.3
1795/99 c	720	132.0	6.6	855	136.4	7.1	661	140.6	7.5	573	146.3	8.5
1800/04 c	460	132.0	6.2	535	136.5	6.6	735	140.9	7.4	814	145.9	8.2
1805/09 c	2	132.0	6.5	434	136.2	6.4	223	141.3	7.3	21	147.2	8.4

	16 yrs.		N	17 yrs.		N	18 yrs.	
	N	s. d.		H	s. d.		H	s. d.
1735/44 ^a				n.a.*			n.a.	
1745/55 ^a	22	3.8		156.2			n.a.	
1760/64 ^b	16	7.2		156.2		9	163.7	5.5
1765/69 ^b				n.a.			n.a.	
1770/74 ^b			9	157.4	6.4		n.a.	
1775/79 ^c	14	10.2	9	161.2	4.5		n.a.	
1780/84 ^c	110	7.5	207	160.8	7.2	49	161.7	5.2
1785/89 ^c	365	8.0	208	160.2	6.1	48	163.3	4.0
1790/94 ^c	553	8.3	430	157.3	7.6	115	159.1	5.9
1795/99 ^c	336	2.9	270	158.4	7.4	61	160.0	6.1
1800/04 ^c	648	8.2	447	158.3	7.8	39	161.5	6.1
1805/09 ^c				n.a.			n.a.	

Table 2: Height of Boys in the Habsburg Monarchy (all nationalities)

a = Aristocrats

b = Orphans

c = Students in military boarding schools

N = number of observations

H = mean height in cm

s. d. = standard deviation of the height in cm

Source: Kriegsarchiv, Vienna. Standstabellen Erziehungshäuser Faszikel 3925, 3926, 3927 and Josephinische Waisenhaus, Faszikel 3922.

* Datum discarded because it was an outlier due to sampling or measurement error.

the aristocracy was sufficiently large so that their food intake would not have been affected by favorable harvest conditions, that is not borne out by the evidence. Cadets attending the academy were recruited from the lower ranks of the aristocracy, sons of aristocrats who lacked sufficient finances to educate their sons themselves, although those whose father served in government administration for 20 years or who were sons of "brave" officers were also admitted. Maria Theresia usually chose the poorest candidates⁹). As a consequence of this selection bias, it is more plausible that the nutritional status of the lower aristocracy was improving at that time. The fall in cereal prices could have made sufficient impact on their real income to affect their nutritional status. One might note that their higher income compared to the rest of the population could have provided a greater quantity of food, but not necessarily better quality. In addition, they drank the same water and were exposed to the same diseases which laid claim to nutrients as the population at large¹⁰).

In spite of the increases in their stature, aristocratic youth in the Habsburg monarchy remained relatively short. They were shorter than German aristocrats in the Carlschule¹¹) who, in turn, were shorter than English aristocrats of the same age attending Sandhurst Military Academy¹²). This pattern supports the notion that aristocrats in different countries were accustomed to a different diet, probably because of different real incomes. Since real incomes of various classes of the population differed from one another, so did their height¹³). German aristocrats were taller than middle class boys of the same age in spite of their consuming the same institutional food after they were eight years old¹⁴), indicating the importance of early nutrition to human growth.

Since data on German and Habsburg aristocratic youth are separated by a generation, a direct comparison is not totally warranted during a period when

in inventories increased greatly in the 1730s and 1740s. This correlates well with contemporaneous increases in stature in the colonies. Sarah M c M a h o n, "Provisions Laid up for the Family: Towards a History of Diet in New England, 1650 - 1850", *Historical Methods* 14 (1981), 1, pp. 22 - 30; Robert F o g e l, "Nutrition and the Decline in Mortality since 1700; Some Preliminary Findings," in: Stanley E n g e r m a n and Robert G a l l m a n (eds.), *Long Term Factors in American Economic Growth* (Chicago, 1987).
9) Th. L e i t n e r v o n L e i t n e r t r e u, *Geschichte der Wiener Neustädter Militärakademie* (Hermannstadt, 1852).

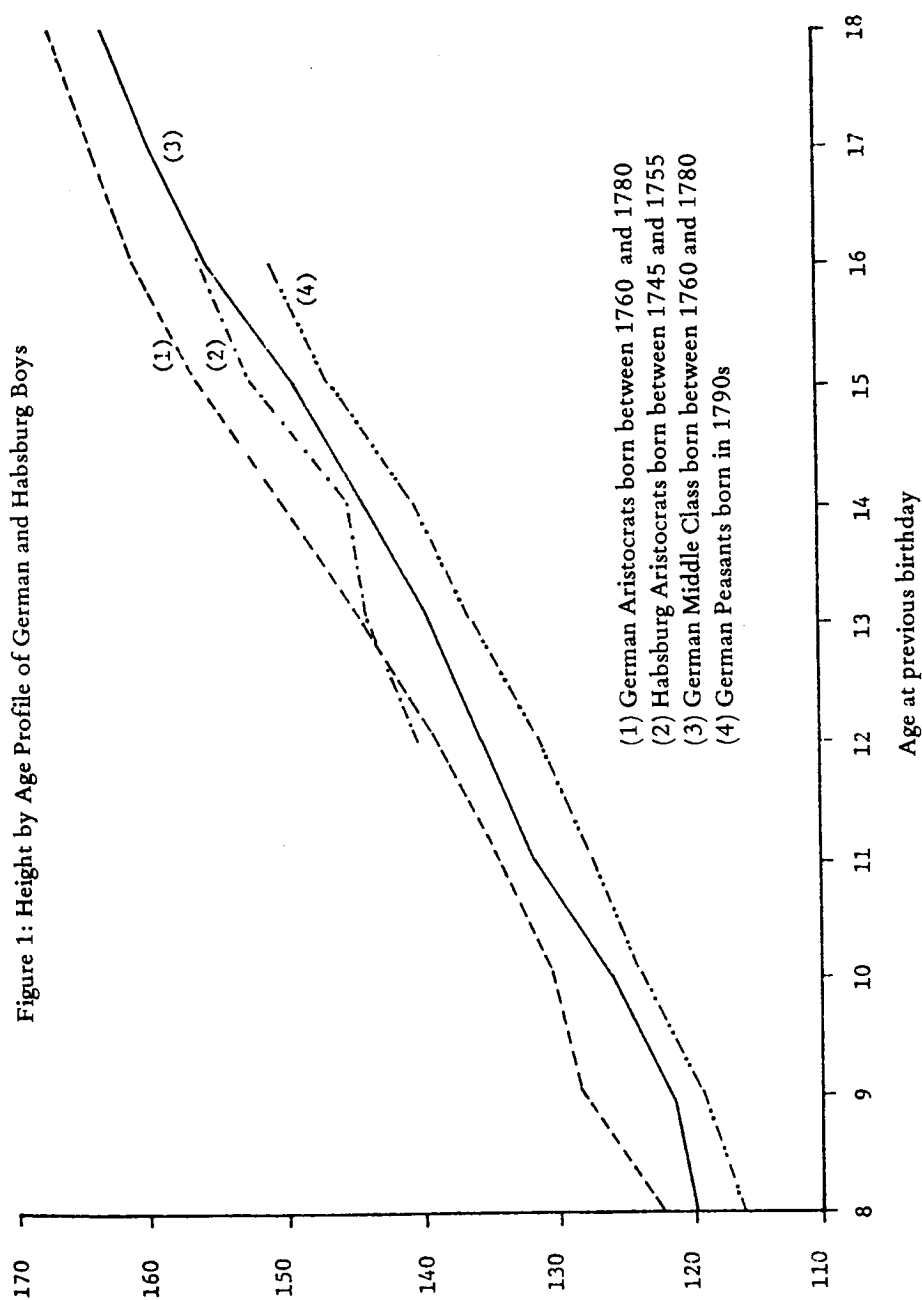
10) Susan C. W a t k i n s and Etienne v a n d e W a l l e, "Nutrition, Mortality, and Population Size: Malthus' Court of Last Resort," *Journal of Interdisciplinary History*, 14 (1983), p. 224.

11) Waltraud H a r t m a n n, "Beobachtungen zur Akzeleration des Längenwachstums in der zweiten Hälfte des 18. Jahrhunderts" (Doctoral dissertation, Frankfurt, 1970), pp. 87 - 119; and Table 10.

12) Personal communication from Professor Roderick Floud.

13) Richard S t e c k e l, "Height and Per Capita Income," *Historical Methods* 16 (1983), 1, pp. 1 - 7.

14) H a r t m a n n, "Beobachtungen," pp. 9, 25.



nutritional status was changing rapidly in Europe. Nonetheless, one might note that Habsburg aristocrats born between 1745 and 1755 were about the same height as German aristocratic youth born between 1760 and 1780 until age 13 (Figure 1). Thereafter, German aristocratic youth experienced an earlier and greater adolescent growth spurt than Habsburg aristocratic youth, whose height became closer to that of German middle class boys between the ages of 14 and 18.

That the Habsburg aristocratic youth were not taller than boys in the Austrian orphanage is truly puzzling because one would have expected that the diet of orphans was inferior to that of aristocrats. The two data sets, however, are separated from one another by two decades, so it is conceivable that the aristocrats' height continued to increase and by the 1760s they would have been taller than the orphans.

The pattern of variation of the lower class boys' height by place of birth is complex because differences in the growth pattern appear over time as well as at various ages. Among orphans born in the 1760s and 1770s, Galician boys alone were significantly shorter than average (Table 3, Equation 3). Considering the whole period thereafter, only Carinthian and Croatian boys were consistently taller than average. Croats were on average 2.4 cm taller than Bohemians. (There are, however, only 412 Croats in the sample). Boys of Bohemian, Lower Austrian, and Hungarian birth, whose stature averages were not significantly different from one another, comprised 40 percent of the whole sample (Table 3, Equation 4).

	1760-79 ^a (3)	1760-1815 ^b (4)
Intercept	106.0 *	109.6 *
Birthyear		
1760		2.8 *
1770		- 0.5
1790		- 1.5 *
1800		- 1.6 *
1805		- 1.5 *
1810		- 0.7 *
Birthplace		
Moravia	- 0.7	- 0.6 *
Silesia	2.3	- 1.7 *
Galicia	- 6.6 *	- 1.2 *
Styria	- 0.8	- 1.0 *

Hungary	0.7	0.2
Upper Austria	- 5.2	- 1.0 *
Lower Austria	- 4.3	0.2
Other	- 0.6	0.2
Carinthia	0.6 *	
Italy	0.0	
Germany	- 0.3	
France	- 0.5	
Tyrol	- 0.8 *	
Transylvania	0.4	
Croatia	2.4 *	
Age		
7+	8.2 *	4.4 *
8+	11.3 *	8.4 *
9+	16.4 *	12.0 *
10+	22.6 *	15.9 *
11+	28.4 *	20.1 *
12+	30.4 *	24.0 *
13+	34.7 *	28.4 *
14+	40.2 *	33.0 *
15+	46.6 *	38.3 *
16+	50.0 *	44.6 *
17+	51.6 *	50.3 *
18+	58.0 *	52.3 *
F =	120.7	3251.6
P =	.0001	.0001
R ² =	0.83	0.81
N =	489	25,071

Table 3. Equations 3 - 4. (Dependent variable: Height in cm)

Equation (3): Intercept indicates the height of a 6-year-old boy born in Bohemia.

Equation (4): Intercept indicates the height of a 6-year-old Bohemian born in the 1780s.

Note: a = orphans, b = students

All independent variables are dummy variables.

* Coefficient significant at the 1% level.

	Age									
	7		8		9		10		11	
	1790s	1800s	1810s	1790s	1800s	1820s	1790s	1800s	1790s	1800s
Moravia	111.98			115.96	117.20	119.54	119.30		123.01	129.55
Bohemia	112.53	113.40	113.40	117.23	116.50	118.20	120.40	119.70	124.04	127.77
Silesia									123.66	126.59
Galicia	110.90			115.20				118.00	122.29	126.51
Other	110.66	112.05		116.10	116.00			120.78	124.22	129.16
Steyermärk								118.95	123.50	127.38
Hungary				115.80	116.00	120.55	119.10	124.65	123.80	128.88
L. Austria	110.39	113.00		116.40		120.58	119.40	126.00	124.08	127.80
Germany			116.28			119.40		123.89	127.60	
Transylvania						119.86		123.40		128.36

	Age									
	12		13		14		15		16	
	1790s	1800s	1790s	1800s	1790s	1800s	1780s	1790s	1780s	1800s
Moravia	132.10	131.70	136.51	135.90	139.96	139.97	145.00	145.56	144.50	154.23
Bohemia	131.70	131.85	135.71	136.30	140.70	141.40	148.10	146.30	146.10	155.04
Silesia										151.80
Galicia	130.22	131.54		136.52	140.06	140.20		144.81	145.90	150.40
Other	132.30	132.90	136.20		141.44	142.00		146.50	148.30	152.28
Steyermärk		132.26								153.00
Hungary	132.52	133.09	138.45	136.90	142.00	142.25		147.50	146.20	156.53
L. Austria	133.30	131.86	137.50	137.00	140.30	140.85		147.69	145.80	151.36
Germany	131.46		136.40		140.61			146.79		151.09
Transylvania		133.20		135.10						

	Age		
	1780s	1790s	1800s
Moravia	159.20	157.90	157.90
Bohemia	161.60	157.60	
Silesia			
Galicia			
Other		157.24	158.90
Steyrmark			
Hungary		158.71	
L. Austria			
Germany			
Transylvania			

Table 4. Height of boys in the Habsburg Monarchy by place of birth in centimeter.

The overall pattern varied greatly from decade to decade (Table 4), and differences in stature by place of birth were generally very small (Figures 2 - 5). Nonetheless, the following features are evident. Hungarian boys born in the 1790s experienced the adolescent growth spurt earlier than other nationalities and were therefore taller than average after age 13 (Figure 2). The growth experience of Lower Austrian boys born in the 1790s was just the reverse of that of the Hungarians. They were taller than average at younger ages, but the difference vanished after age 14 (Figure 3). Lower Austrian boys born in the 1800s were substantially taller than average at all ages (Figure 4). During the decades of the 1800s, Galician boys were somewhat shorter than average until age 11, but not thereafter (Figure 5). Because of these variations no definitive conclusion can be made on height differences by place of birth.

While the analysis of boys' height by place of birth remains ambiguous, a striking trend in stature emerges over time. Increases in height at all ages experienced by the aristocratic youth in the 1740s and 1750s were reversed after the 1760s. Orphans as well as students in military schools declined in stature consistently at all ages throughout the period between 1760 and 1800 (Figure 6 and Table 2). The difference between heights attained in the 1760s or 1770s and those of the 1780s ranged from 0.3 to 4.5 cm at various ages. Even though the number of observations in the beginning of the period is small, the pattern is consistent at all ages, thereby supporting this generalization. This phenomenon is all the more extraordinary since one would have expected boys in orphanages, on which the sample of the 1760s and 1770s is based, to have been less well nourished than those in military schools. The decline in height is not because the data stem from different institutions: the stature of boys of all ages continued to decline until the early nineteenth century. In the 1790s the decline was no longer substantial. It was generally less than one cm with the exception of boys 15 years or older. Their average height declined in the 1790s by three cm or more (Table 2). The nutritional status of the boys did not stabilize until those cohorts who were measured after the end of the Napoleonic Wars (Figure 7). The growth curve of those born in the 1800s is not depicted in Figure 7; however, it coincides with the curve marked 1790s. Eighteen-year-olds born after 1800 were, however, taller than those born in the 1790s. This pattern is unexpected because unusually bad harvests prevailed throughout Europe in 1816 - 17, and the end of the Napoleonic Wars has not been associated with an increase in the standard of living, or with increased economic activity 15).

15) John P o s t , *The Last Great Subsistence Crisis in the Western World* (Baltimore, 1977). John K o m l o s , *The Habsburg Monarchy as a Customs Union: Economic Development in Austria-Hungary in the Nineteenth Century* (Princeton, 1983), p. 99.

Figure 2: Height by Age Profile of Habsburg Boys, born between 1790 and 1799

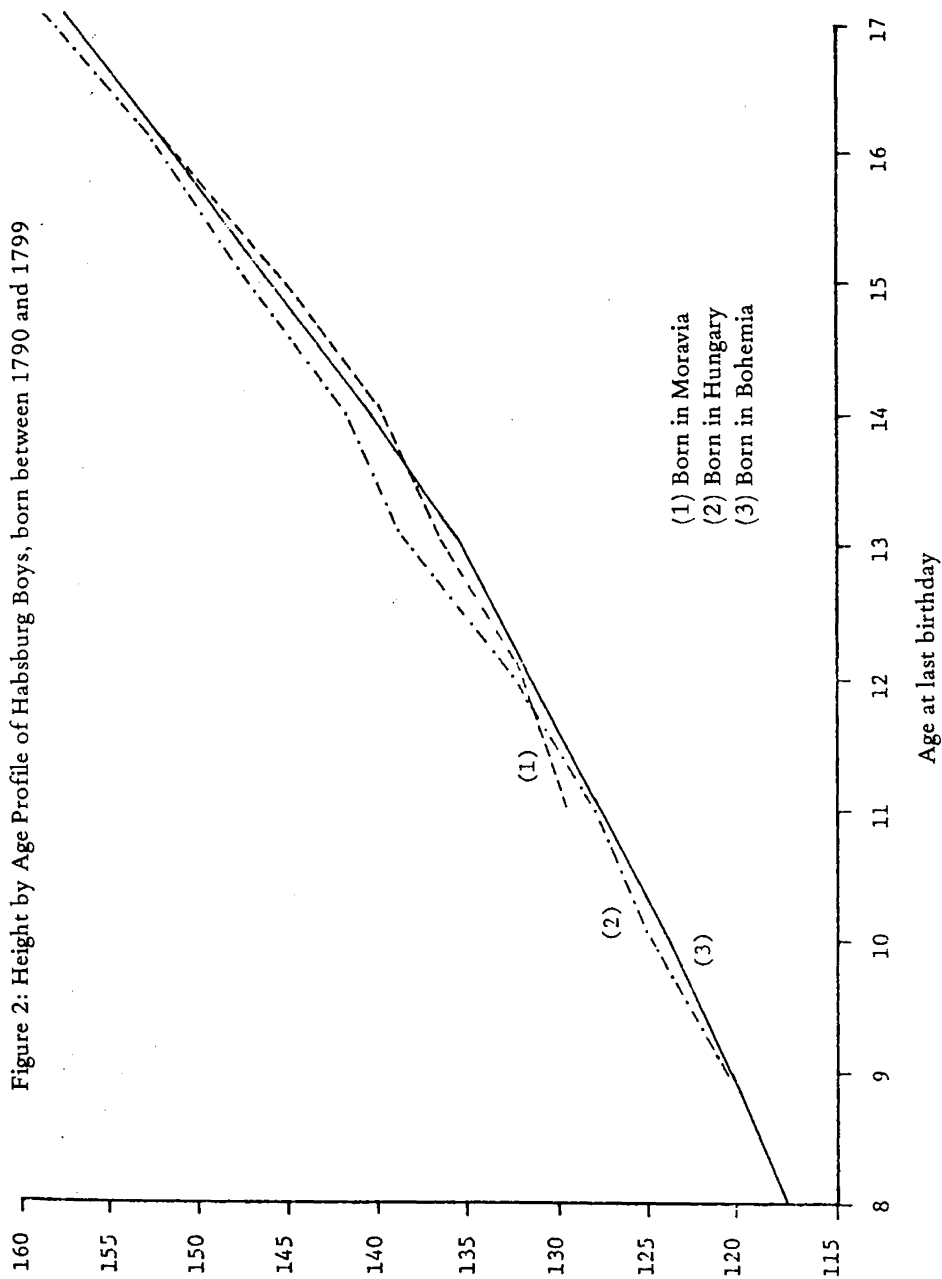


Figure 3: Height by Age Profile of Habsburg Boys, born between 1790 and 1799

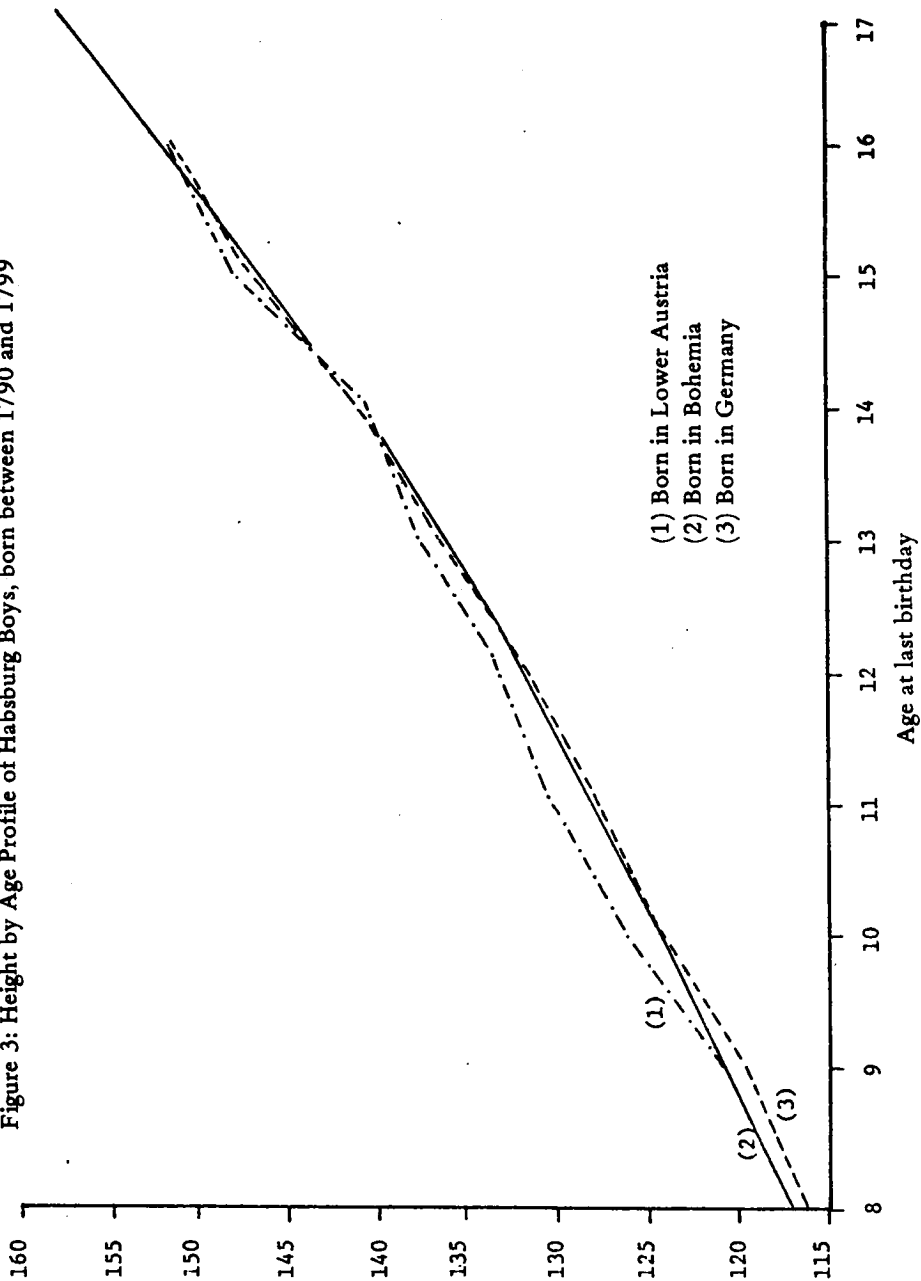


Figure 4: Height by Age Profile of Habsburg Boys, born between 1800 and 1809

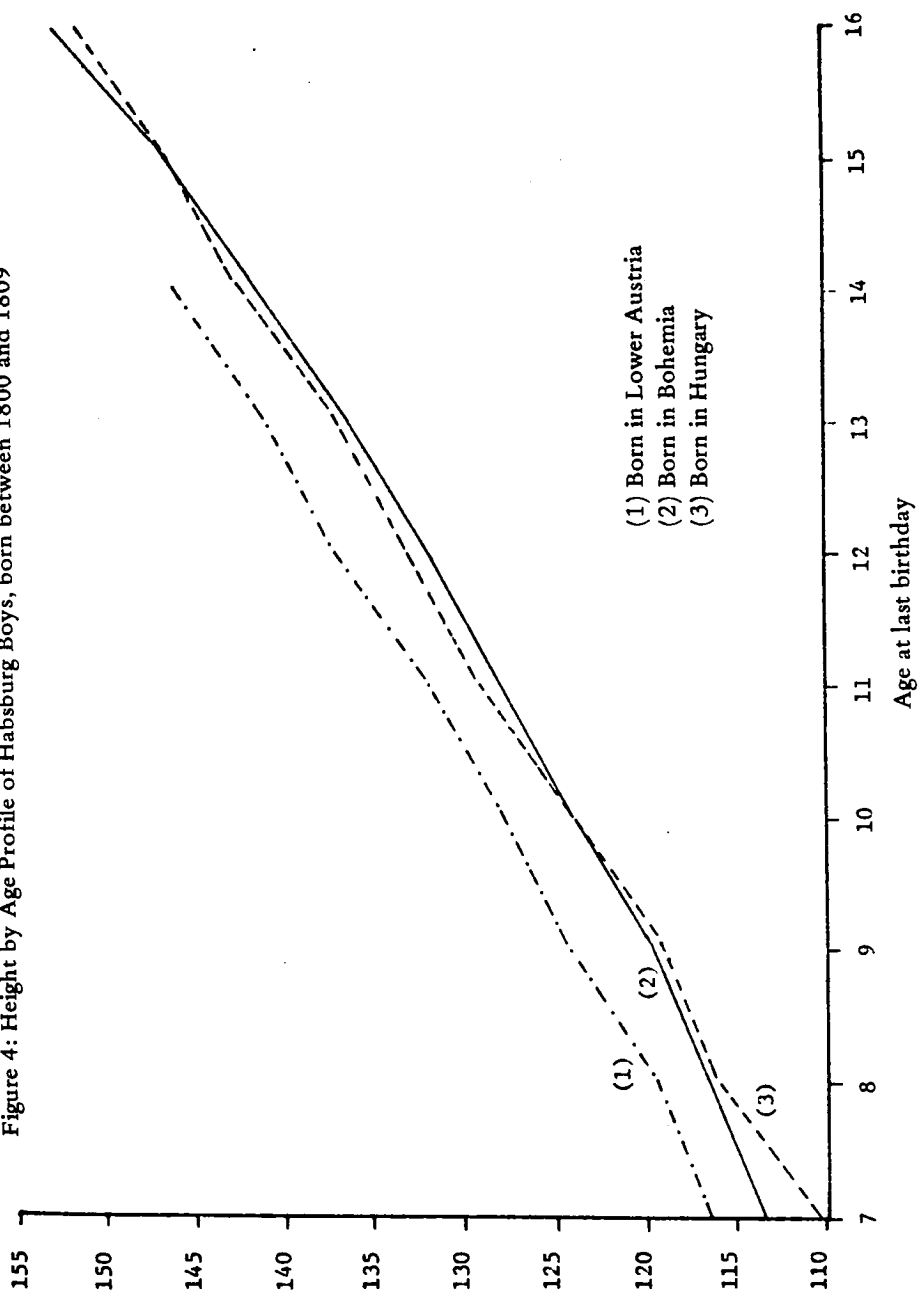


Figure 5: Height by Age Profile of Habsburg Boys, born between 1800 and 1809

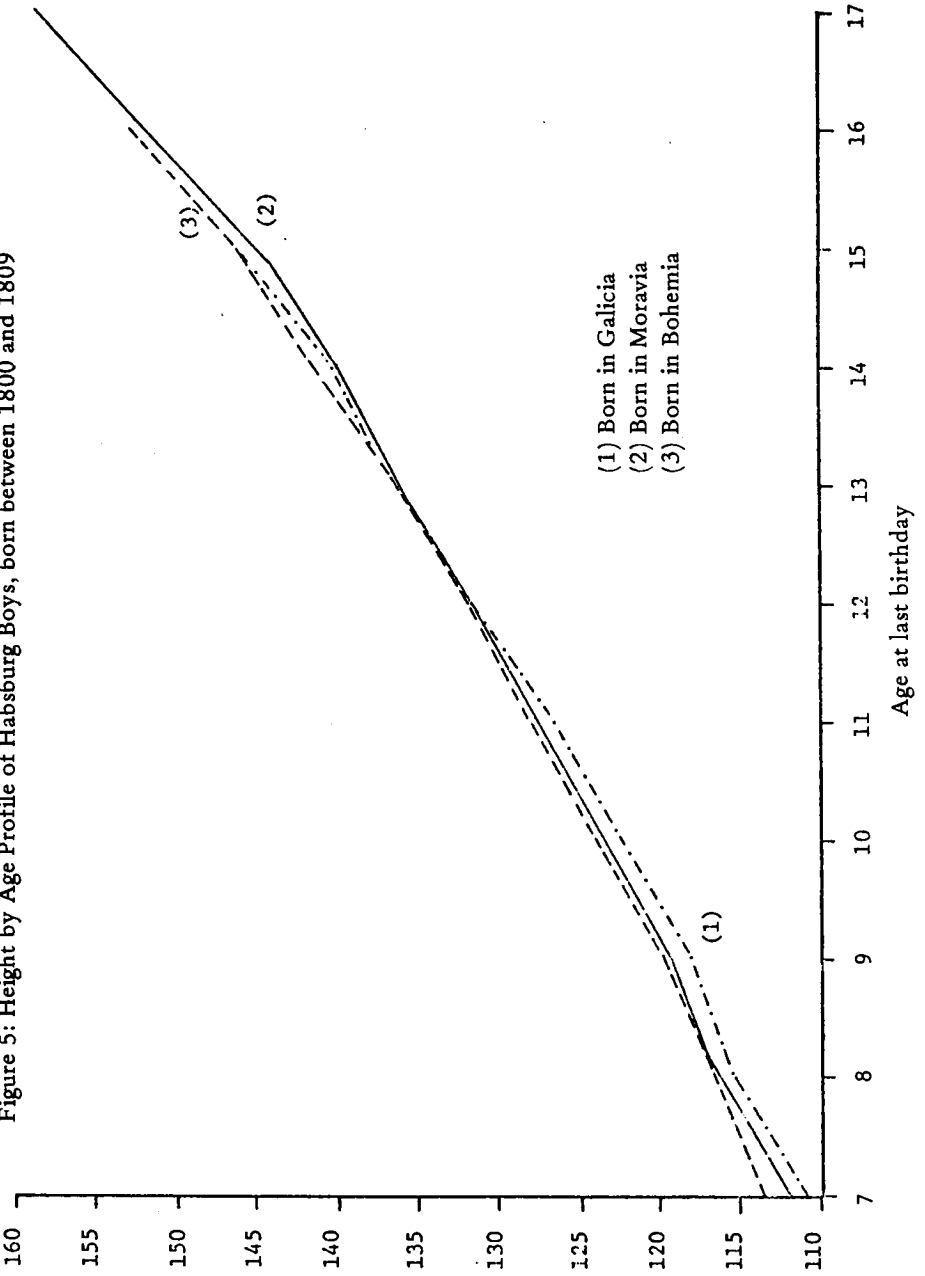


Figure 6: Height of Boys in the Habsburg Monarchy by Date of Birth

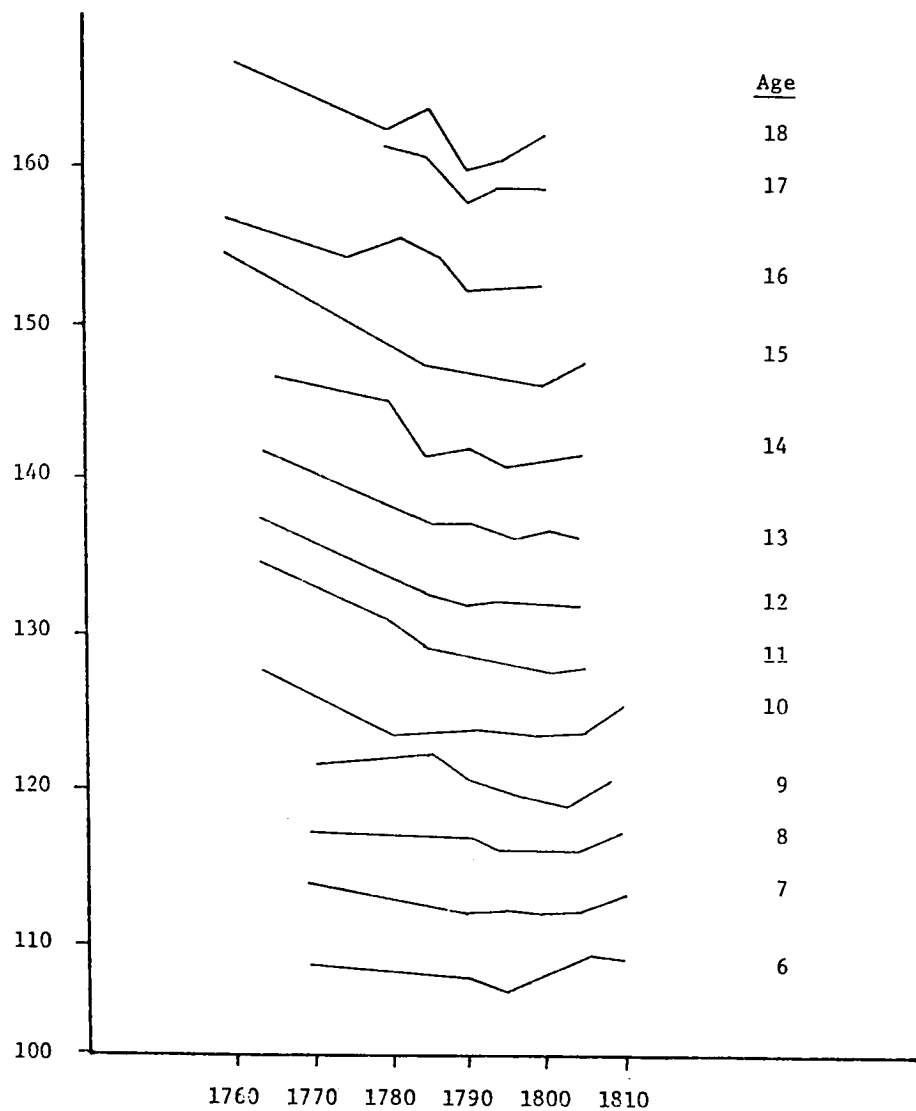
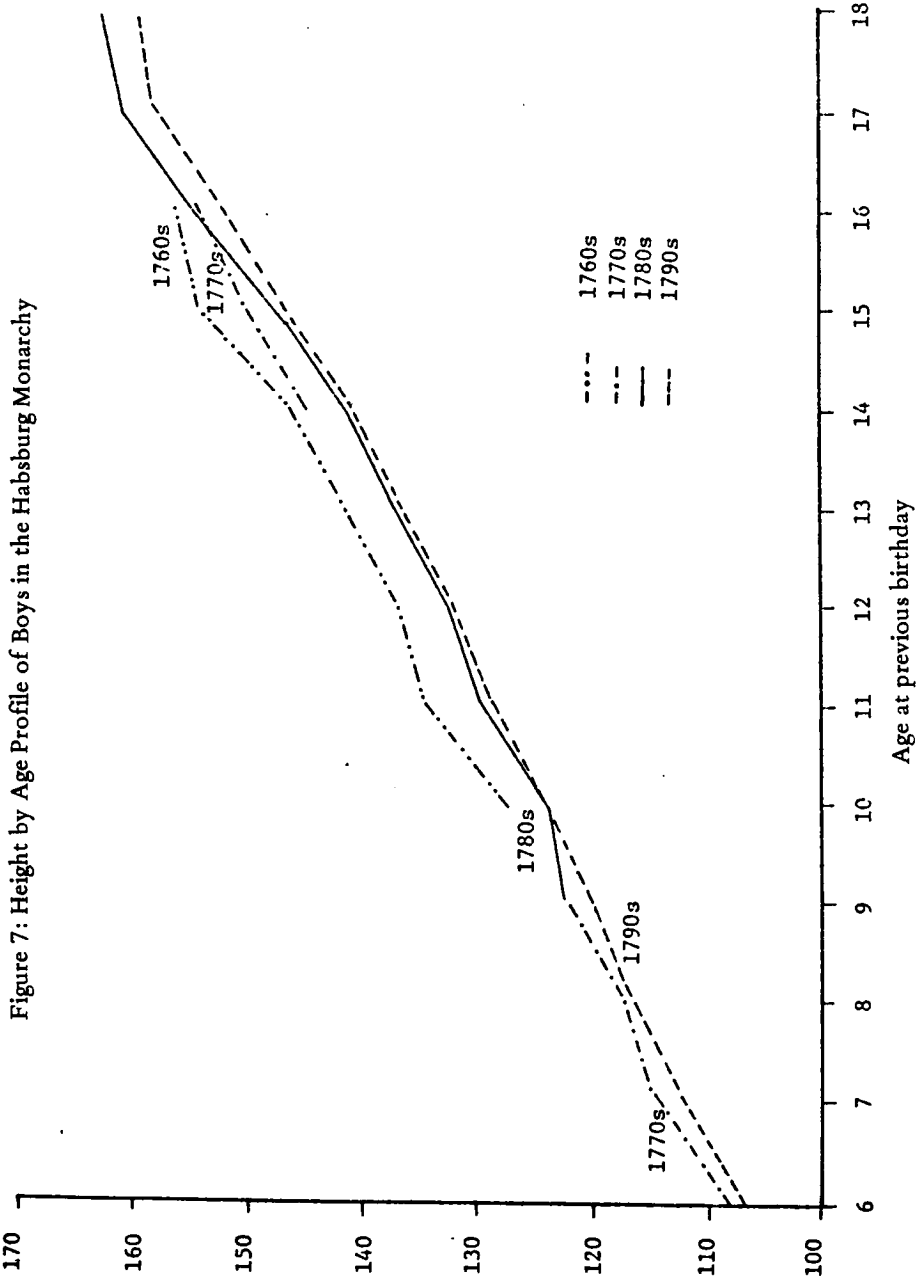


Figure 7: Height by Age Profile of Boys in the Habsburg Monarchy



	<u>6 yrs</u>	<u>10 yrs</u>	<u>13 yrs</u>	<u>14 yrs</u>	<u>15 yrs</u>	<u>16 yrs</u>	<u>18 yrs</u>
1) 1800 Habsburg Monarchy	108	124	137	141	146	152	162
2) 1760/80 German Middle Class		128	140	144	150	155	163
3) 1760/80 German Aristocrat		131	144	151	156	161	167
4) 1800 London poor			132	135	142	147	
5) 1800 London gentry			148	156	161		
6) 1800 France						167	170
7) United States slave		127	142	146	152	159	166
8) 1840 United States						167	171
9) 1900 Russian poor Jews					147	153	162
10) 1920 Vienna					152	155	160
11) 1923 Vienna					151	158	164
12) 1981 Austria	124	141		166			180

Table 5. Comparison of the Height of Boys of Selected Ages in Various Countries 1800 - 1981 (cm)

Sources:

Row 1: Table 2.

Rows 2 and 3: Hartmann, 1970.

Rows 4 and 5: Personal communication from Professor Roderick Floud.

Row 6: Jean Sutter, René Izac and Tran Ngoc Toan, "L'Évolution de la Taille des Polytechniciens," Population (July - Sept., 1958) pp. 373 - 406.

Row 7: Richard Steckel, "Slave Height Profiles from Coastwise Manifests," Explorations in Economic History, 16 (1979), 363 - 380. Average stature during early nineteenth century.

Row 8: Archive, United States Military Academy, West Point. Number of observations: 514. Stature at ages other than reported above was: 17: 169.2 cm; 19: 171.6 cm; 20: 172.7 cm.

Rows 9, 10 and 11: Nobel, 1924.

Row 12: Österreichischen Statistischen Zentralamt.

Growth increments (growth per annum) during adolescence are another indicator of nutritional status. The age at which the greatest increment is reached, and its size is sensitive to nutritional status. The lower the status, the later is the greatest increment experienced, and the smaller it is. Analysis of the growth increment over time confirms that the nutritional intake of boys under consideration was declining between 1760 and 1800, and that the decline was reversed thereafter 16).

The diminution of height throughout the late eighteenth century is in accordance with what is known about economic circumstances of the period, particularly about agricultural conditions 17). The rise in grain prices and concomitant fall in real wages imply a decline in the standard of living; data on the trend in stature substantiate this notion with direct evidence. Adult male heights in the Habsburg monarchy also diminished during the latter half of the century 18). Data on Swedish conscripts evinced a similar pattern, with the decline particularly noticeable among 19-, 20-, and 21-year-old soldiers, but less so with those over 25 19). Slum boys in London also suffered enormously during the last decades of the eighteenth century. They did, however, experience a phenomenal increase in stature after the end of the war in 1815. The increase in a matter of years was as much as 12 centimeters. The pattern of the stature of American slaves, too, followed a very similar cycle of deterioration and recuperation around the turn of the century 20). This evidence indicates that the nutritional crisis was not confined to East-Central Europe, but the free American population, with access to a vast frontier, was not affected 21).

The nutritional status of boys in military boarding schools compares favorably with the height of poor London boys. Boys in our sample were four to six cm taller than poor London boys. American slaves, however, were considerably taller in the early nineteenth century (Table 5). Gentry boys attending Sandhurst Military Academy in England were also much taller. Compared with early twentieth-century standards, boys of the Habsburg monarchy were small in stature. At age

16) For a more extensive analysis of this aspect of the data, see the version of this article in the *Annals of Human Biology*.

17) Wilhelm Abel, *Agrarkrisen und Agrarkonjunktur* (Hamburg, 1966; 1st ed., 1935), p. 241. Wilhelm Abel, *Massenarmut und Hungerkrisen im vorindustriellen Europa* (Berlin 1974), p. 14.

18) Komlos, "Stature and Nutrition in the Habsburg Monarchy".

19) Lars G. Sandberg and Richard Steckel, "Soldier, Soldier, What Made You Grow so Tall?" *Economy and History* 23 (1980), 2, pp. 91 - 105. I thank Richard Steckel for sending me an updated version of their calculations.

20) Richard Steckel, "Slave Height Profiles from Coastwide Manifests," *Explorations in Economic History*, 16 (1979), pp. 363 - 380.

21) Roderick Floud and Kenneth Wachter, "Poverty and Physical Stature, Evidence on the Standard of Living of London Boys, 1770 - 1870," *Social Science History* 6 (1982), 4, pp. 432 - 433; Fogel, "Nutrition and the Decline in Mortality since 1700".

14, for instance, they lagged ten cm behind the norm in Western Europe established around 1900. At the turn of the twentieth century there were, however, still some European populations with whom the Habsburg boys were comparable, such as poverty-stricken Russian Jews (Table 5). Viennese children who lived through the First World War were only slightly taller in 1920. Shortly after the war, however, their nutritional status began to improve²²).

Compared with contemporary Austrian children, boys in the Habsburg military schools appear to have been tiny (Table 5). They were between 16 to 18 cm shorter — a difference of about four years of growth. In fact, there is not a single European population or population in North or South America of European ancestry with whom the Habsburg boys of the eighteenth or early nineteenth century are comparable. Children of Taipei, Hong Kong, Japan, Alaska, and South Korea are also all taller. One can find comparable heights only among such truly underdeveloped nations as Thailand, India, rural Burma, some areas of Mexico, or among the Maya in Guatemala, the Hutu in Rwanda, the Bush negroes of Surinam, and Bolivian children of mixed ancestry²³).

In conclusion, this study, based on the earliest data hitherto discovered on the height of boys and adolescents, shows that stature of those born in the late 1740s increased. This process was reversed for those born after the 1760s. This evidence confirms directly for the first time the notion often expressed in the literature that the rise in cereal prices during the second half of the eighteenth century had a detrimental effect on the standard of living²⁴). The deterioration, however, was not a consequence of industrialization since the data stem from an overwhelmingly agricultural society. Nor was the deterioration caused by the Napoleonic Wars; the diminution in stature preceded the outbreak of conflict. To be sure, the adverse effect of the war is detectable: height recovered somewhat after its conclusion, but not nearly to the levels of the 1760s. The decline in nutritional status is most easily explained by the acceleration of population growth which caused per capita agricultural output to diminish because of diminishing returns to labor in this sector. In sum, the secular pattern of stature of boys in the Habsburg monarchy enables one to gain an insight into the changes in economic conditions of this society.

22) C. Pirquet, "Eine einfache Tafel zur Bestimmung von Wachstum und Ernährungszustand bei Kindern," *Zeitschrift für Kinderheilkunde* 6 (1913), p. 255; E. Nobel, "Anthropometrische Untersuchungen an Jugendlichen in Wien," *Zeitschrift für Kinderheilkunde* 36 (1924), pp. 13 - 16.

23) Phyllis B. Evely and James M. Tanner, *Worldwide Variation in Human Growth* (Cambridge, 1976), pp. 277, 307, 331, 388.

24) Abel, *Massenarmut*.